Development of Sophisticated Fractionation of Fine Particles Suspended in Liquid Using Sodium Chloride

Eiji Iritani and Yasuhito Mukai
Department of Chemical Engineering, Graduate School of Engineering, Nagoya University

Summary

The establishment of the fractionation technique of particles in multi-component suspension is an important problem that concerns the recovery of valuable materials and the removal of harmful substances. In this study, a method was developed for separating several fine particles by changing the surface potential of particles using sodium chloride (NaCl).

The materials used in the experiment are three kind of submicron particles, Fe_2O_3, SiO_2, ZrO_2, with the original mean particle size of 0.51μm, 1.29μm, 0.69μm and with the isoelectric point of 8.2, < 3, 6.1, respectively. The sedimentation test of the suspensions including these particles was conducted at pH 9 under various NaCl concentrations, *c*, and then the time variations of a mass fraction of each particle in suspension were measured at the upper and lower part in sedimentation tube. At the concentration less than 0.025mol/l, all the particles dispersed due to the electrostatic repulsion between particles, while at the concentration of 0.03mol/l, Fe_2O_3 and ZrO_2 tended to flocculate and thus precipitate due to the reduction of the zeta potentials. Furthermore, Fe_2O_3 and ZrO_2 flocculated more significantly at the concentration of 0.035mol/l and 0.04mol/l. As a result, SiO_2 was successfully separated from Fe_2O_3 and ZrO_2. However, an excess addition of NaCl (c = 0.3mol/l) led to the precipitation of all the particles. Thus, it is concluded that the control of NaCl addition plays an important role in the behaviors of the particle fractionation.

On the other hand, in the experiment performed under various pH conditions without NaCl addition, the effective fractionation couldn't be observed. For instance, at pH 4 where Fe_2O_3 and ZrO_2 are positively charged and SiO_2 is negatively charged, the heterocoagulation occurred due to electrostatic attraction and therefore all the particles settled down. Also at pH 6, all the particles flocculated since ZrO_2 had almost zero potential and Fe_2O_3 and SiO_2 were oppositely charged each other. At pH 8, Fe_2O_3 flocculated completely and SiO_2 dispersed. However, ZrO_2 flocculated moderately, resulting in a failure in the fractionation.

In conclusion, when the NaCl concentration is adjusted appropriately under the pH condition where all the particles disperse due to a repulsive force, the effective fractionation associated with the selective flocculation is attained.